APPLIANCE STANDARDS

How they interact with energy efficiency programs

APPLIANCE STANDARDS: WHERE DID MY SAVINGS GO?

Alas, those mercurial baselines.

Since 2005, 45 mandatory Department of Energy (DOE) efficiency standards have taken or will soon take effect, removing from the market the most inefficient products across all end-uses and sectors. And the steady beat of new standards will continue to raise the bar, reaching deep into the pockets of residential, commercial and industrial programs.

The net result to program managers: higher baselines. But does that mean lower savings? Yes and no.

It certainly means we shouldn't continue to pay for what standards have locked in. The low hanging fruit is not what it used to be. But just because the savings cannot be claimed programmatically doesn't mean they don't exist. Those savings, those average megawatts – that power resource we are all after – did not go away. They are simply in the baseline after the standard takes effect. That's good news because they are just as real.

This new standards-driven efficiency landscape has significant implications for demand-side management policy and strategy. For the most part, the timing of DOE standards is known three to five years ahead of time and can be included in program planning. By looking forward, program managers and planners can anticipate changes to baselines and to the markets in which their programs operate. And programs can tailor their design and focus resources where the impact will be greatest over the long term.

SECTION 1: OVERVIEW

DEPARTMENT OF ENERGY (DOE) STANDARDS 101

Either Congress or DOE can set new Federal efficiency standards for "covered products" – appliances and equipment types over which DOE has the authority to regulate. For example, the residential refrigerator is one such "covered product."

DOE typically sets standards through a three year process called a rulemaking, which involves extensive public review and feedback.

Different standards apply to what DOE calls "product classes." Your refrigerator with the freezer on top is subject to a more stringent standard than the Jones' French Door model across the street because the two types are different product classes.

Typically, manufacturers have 3 to 5 years to comply after a standard is finalized.

Once in force, manufacturers can no longer make or import products that do not comply, although retailers may continue to sell existing stock.

WHAT'S THE BIG DEAL ABOUT FEDERAL STANDARDS?

First, the range of consumer products and commercial equipment "covered" by DOE – that is, subject to standards – now addresses a growing majority of building end-use energy consumption. Nearly 80 percent of residential energy use is consumed by products subject to DOE standards. For commercial and industrial equipment, the share is smaller but growing quickly as DOE is considering standards for new product categories like commercial and industrial pumps.

Second, we are in the midst of an unprecedented increase in DOE standards activity *(fig.2)*.

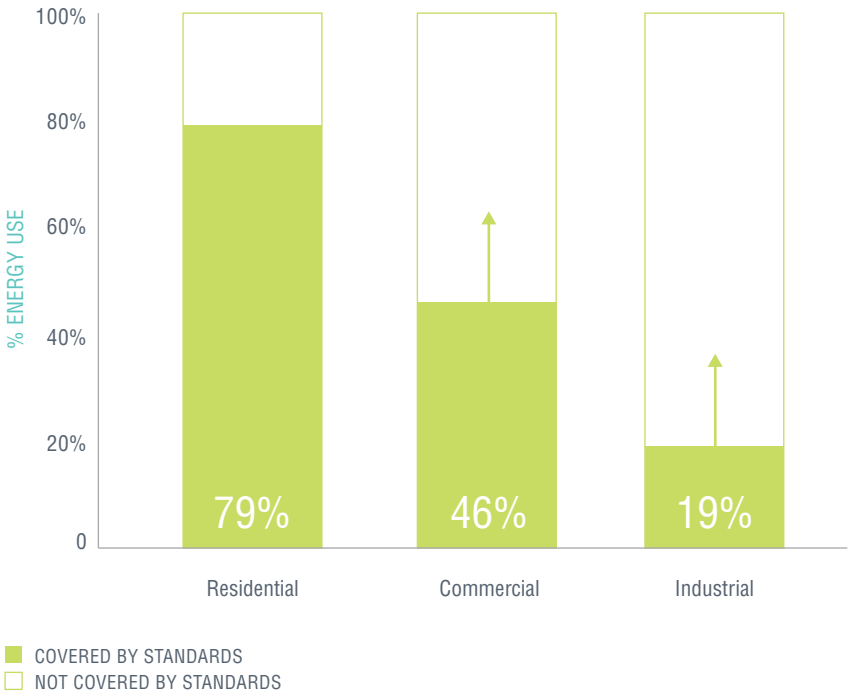


Figure 1

Share of building energy use subject to DOE standards, by sector.

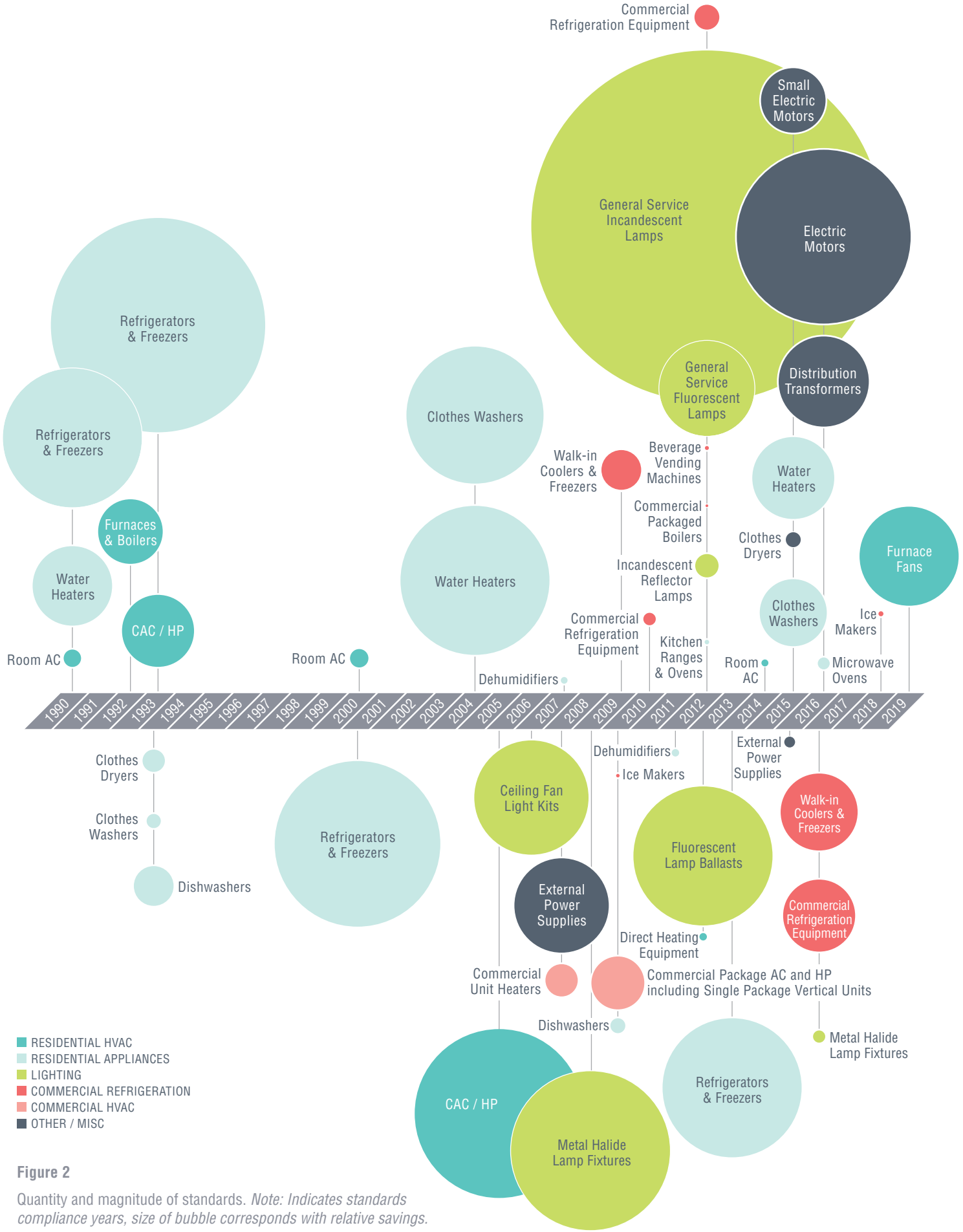


Figure 2

Quantity and magnitude of standards. *Note: Indicates standards compliance years, size of bubble corresponds with relative savings.*

HOW EXACTLY DO FEDERAL STANDARDS AFFECT THE PROGRAM?

BASELINE IMPACTS

Baselines are the lynchpins to program cost-effectiveness. Assumptions about measure baselines therefore guide effective resource allocation at the efficiency program and portfolio level. Program managers and planners should understand how DOE standards can impact those assumptions. Standards can have a direct or indirect impact on baselines.

DIRECT BASELINE IMPACTS The direct impact is most easily understood – the new standard simply raises the baseline, cutting the savings attributable to the measure. This direct impact occurs when the measure (e.g., a new clothes washer) is the same product for which DOE established a new standard.

However, even in this straightforward "direct" case, new standards impact program measure baselines differently depending on how the baseline was estimated or calculated. The Regional Technical Forum (RTF) uses several methods to estimate "current practice" baselines for its deemed measure list. A current practice baseline is meant to reflect the code minimum or market average, whichever is more efficient. Data availability typically dictates which baseline estimation method is used for any one measure and for this reason, the market average of the sales flow (an ideal baseline) is seldom used.

The most common RTF methods for representing a measure's baseline are shown in the table below, along with an example, the key assumption, and a brief look at how a DOE standard could impact that method.

BASELINE 101

Energy efficiency planners and program managers in the Northwest operate amid baselines from different sources with different meanings.

POWER PLAN BASELINES

Northwest Power and Conservation Council's regional conservation supply curves are composed of a roll up of individual measures. Each measure has a baseline, which is frozen throughout the plan analysis period. Savings targets are counted against these baselines.

If the Plan developers know a DOE standard will take effect during the Plan period, they include the standard in the baseline of the measures it will affect.

RTF BASELINES

The Regional Technical Forum recommends baselines for conservation measures on an ongoing basis. The measure baselines are updated on a predetermined schedule and can change to reflect new DOE standards that impact a given measure. They are not necessarily consistent with the Plan baselines.

IMPACT OF DOE STANDARDS

Predicting the impact a DOE standard will have on a baseline is not as straightforward as it may seem. A given measure's definition, the methodology used to develop its baseline, and the nature of the relevant DOE standard all affect the ultimate impact.

Table 1

Impact of DOE standards on RTF baseline

BASELINE ESTIMATION METHOD	EXAMPLE	KEY ASSUMPTION (IF BASELINE IS INTENDED TO REFLECT CURRENT PRACTICE MARKET AVERAGE)	IMPACT OF NEW HIGHER DOE MINIMUM EFFICIENCY
Use the average efficiency of the product in the installed stock	For residential lamps, the baseline is the average of residential lamp wattages found in NEEA's Residential Building Stock Assessment.	The product mix in the installed stock at the time of the field study is the same as the sales mix currently.	Newly non-compliant units in the stock must be removed from the average calculation, which would likely raise the baseline significantly.
Use the DOE minimum efficiency for the product	For a residential heat pump change out, the baseline assumes a 7.7 HSPF because that is DOE minimum.	All current sales are at the DOE minimum efficiency level.	Most straightforward effect of all baseline estimation methods. The baseline changes proportionally to increase in standards.
Use the average efficiency of models available on the market	For residential refrigerators, the average kWh/year of refrigerators in the California Energy Commission's product database.	The distribution of efficiencies of models available for purchase is the same as the distribution of efficiencies actually purchased.	Newly non-compliant units must be removed from the calculation, which would likely raise the baseline significantly.
Use the average efficiency of recent sales flow data	For clothes washers, the sales-weighted average efficiency as reported by the Association of Home Appliance Manufacturers.	No assumptions – only limited by data availability.	New sales data is averaged in the same way as before; the impact depends on how the market reacts, but the standard is likely to have the lowest impact of all baseline methods.

INDIRECT BASELINE IMPACTS New DOE standards can indirectly impact measure baselines even when they do not apply to the exact program measure. Often, this indirect effect occurs when a DOE standard increases the efficiency of a product that is part of a larger system that a program measure is meant to address. For example, DOE increased the efficiency of linear fluorescent lamps and ballasts, but did not change the required lighting power density of entire spaces. So program measures with LPD baselines are indirectly affected by such standards. This indirect impact can work both ways: when a program measure targets a component of a DOE-covered product, such as with LED lighting in commercial refrigeration cases, the DOE standard can indirectly raise the program baseline. In the commercial refrigeration example, while the standards do not require LED lighting, manufacturers will almost assuredly use LED lighting as a design choice to meet the DOE standard, a de facto change in the baseline for that measure. Table 2 looks at several recent DOE standards and when and how they are likely to impact RTF measures.

Table 2

Recent DOE standards with impacts to RTF measures

DOE COVERED PRODUCT	COMPLIANCE DATE	RTF MEASURES IMPACTED	MAGNITUDE OF IMPACT ON RTF MEASURE	DIRECT / INDIRECT
Clothes Washers*	2018	ENERGY STAR® and CEE clothes washers	Low	Direct
Dishwashers*	2013	ENERGY STAR dishwashers	High	Direct
Refrigerators and Freezers*	2014	ENERGY STAR refrigerators and freezers	High	Direct
Water Heaters*	2015	Heat pump water heater	Medium	Direct
Residential Central Air-Conditioners / Heat Pumps	2016	Existing Single-Family Heat Pump Upgrade	Low	Indirect
		Ductless heat pump	Low	Indirect
		Air-Source Heat Pump conversion from forced air furnace	Low	Indirect
		New single family home HVAC upgrade – heat pump	Low	Indirect
General Service Incandescent Lamps*	2012	Residential lighting – CFL	Medium	Direct
	2012	Residential lighting – LED	Medium	Direct
	2012-2014	Residential lighting – Specialty	Low	Direct
General Service Fluorescent Lamps	2012	Residential lighting – high performance 4-foot T8 lamps	Low	Direct
	2012	Residential lighting – high performance 8-foot T8 lamps	Low	Direct
Metal Halide	2017	Agriculture lighting – area lights	Low	Direct
Commercial Refrigeration Equipment	2012, 2017	ENERGY STAR commercial refrigerators and freezers	High	Direct (2017 standard)
		Anti-sweat heater controls on reach-in doors	Low	Indirect
		De-lamp or replace fluorescent fixtures with LEDs	High for new products	Indirect
		Motion sensors	Low	Indirect
		Replace gaskets	None	N/A
		Use ECMs instead of shaded pole motors	High	Indirect
		Add floating head pressure controls	None	N/A
Walk in Coolers and Freezers	2009, 2017	Compressor head fan motor retrofit to ECM	None	N/A
		Replace gaskets	None	N/A
		Use ECMs instead of shaded pole motors	High	Indirect
		Add floating head pressure controls	High	Indirect
		Installation of strip curtains	High	Direct (2009 standard)
		Motor controller when compressor is not operating	High	Indirect

**RTF measures already account for standards in the measure baseline*

EFFICIENCY MIX IMPACTS

Beyond simply establishing a new baseline in the market and "cutting out the laggards," standards can affect the overall mix of efficiencies sold. The market average efficiency after a standard takes effect depends on how consumers respond to the new minimum. Do they buy products at that new minimum or do they purchase whatever the next ENERGY STAR level is?

When the portion of consumers who would have otherwise bought a lower efficiency product (were it still available on the market) simply migrate to the new baseline, this is known as a roll-up – so named because the sales just "roll up" to meet the new standard. In the roll-up, the shape of the efficiency distribution changes, heavily favoring products at the new baseline.

In contrast to the roll-up, sometimes the entire market shifts as other programs react to standards and consumers maintain their purchasing patterns in the overall efficiency spectrum. This is called a "shift" scenario as the shape of the overall efficiency distribution is the same, just with a new baseline and median efficiency.

PRODUCT MIX IMPACTS

Occasionally, standards do more than change the *efficiency* mix of products in the market. They also change the mix of product *types* in the market. This happens when different products or different product classes are relatively good substitutes in terms of functionality. A good example is clothes washers. For instance, DOE set independent efficiency standards for front-loading and top-loading clothes washers. While the relatively inefficient top-loaders are still cheaper, the standards caused the price gap to shrink. So when comparing the cost and benefits between the two types after the standard, front-loaders come out winners more than before. In this example, front-loaders became relatively more attractive, causing some consumers to "switch" to the more efficient product type.

This switching behavior could have positive or negative consequences on the efficiency impact of the standard overall. One timely example yet to unfold is electric storage water heaters.

ELECTRIC WATER HEATERS

Beginning on April 16, 2015, new electric storage water heaters (the ones with the big tanks) had to comply with DOE's more stringent standards.

It's important to first understand that there are two basic types of electric storage water heaters on the market. The most common type by far is an electric resistance tank which heats the water like an incandescent filament heats the air inside a bulb. The second type, with a small share of the market, is the heat pump water heater. The heat pump water heater is more expensive but more than twice as efficient.

The exact DOE standard level depends on how much water the tank holds. The new efficiency levels are higher for all sizes, but what really matters is what happens to relatively large tanks. All electric waters larger than 55 gallons now must effectively be heat pump water heaters.

TIMING	TECHNOLOGY	APPROXIMATE RETAIL PRICE	ANNUAL ENERGY USAGE (kWh)
BEFORE 2015 STANDARD	Electric Resistance	$400	4,000
AFTER 2015 STANDARD	Heat Pump	$1,600	1,500

Table 3

Comparison of minimally compliant 80-gallon electric water heater, before and after standards

While heat pump water heaters are a proven technology made by several manufacturers, this is nonetheless a substantial change. The efficiency of heat pump water heaters is more than double that of traditional electric resistance water heaters and so is the initial first cost to the end-user. Just how the market reacts to the standard is unknown because in this instance, consumers have many options.

If they are purchasing a new, large-tank water heater, they can:

1. Purchase a more efficient but more expensive heat pump water heater;
2. Purchase a smaller electric resistance water heater;
3. Purchase and install two small water heaters to maintain equivalent water heating capacity as one large tank.

In limited retrofit applications, the space and airflow conditions may influence the purchaser's decision. Regardless, this decision and how plumbers propose the potential options to consumers will ultimately dictate the extent to which the savings from these standards are realized.

PROGRAMS COULD CONSIDER:

1. Market research to identify how plumbers and trade allies are framing the options for consumers. Most water heater purchases are emergency replacements, so when the installer is called and sees she needs to replace an 80 gallon tank, what does she recommend?
2. Ensure plumbers and installers feel adequately trained to install heat pump water heaters. Otherwise, they may feel compelled to propose either option 2 or 3 above.
3. Monitor the market for potential customer switching from large tanks (>55 gallons to <55 gallons). Then design programs, baselines, and rebate levels appropriately.

STRATEGIC PROGRAM IMPLICATIONS: HOW CAN MY PROGRAM COEXIST WITH STANDARDS?

Utilities have long managed programs by targeting products that are also covered by standards. It was a simple formula that worked well: a DOE minimum standard set the floor and programs incented consumers and businesses to voluntarily do better, by providing rebates for ENERGY STAR appliances and other higher efficiency options.

However, the recent volume and magnitude of federal standards will change the game in the coming years and force new and innovative program designs to find a new path to claimable savings. Take the example of residential clothes washers. For these products, the historical improvements in efficiency are so large that little headroom remains for incremental potential. The cost-effectiveness of pushing the market for these products is diminishing.

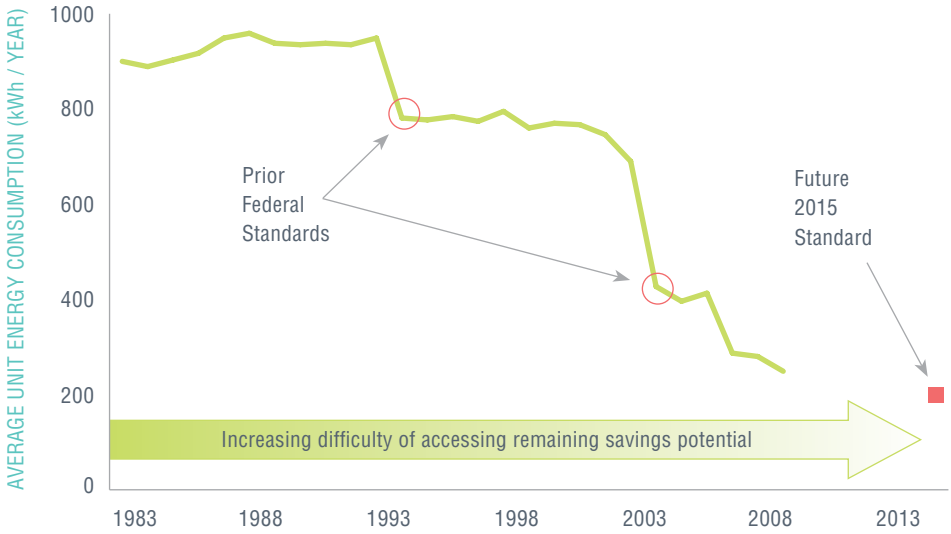


Figure 3

Stringency of Federal standards over time
(clothes washers)

MARKET TRANSFORMATION OVER TIME

While at first glance it would appear that Federal standards are eroding the potential for additional programmatic savings, it's important to remember that the relationship between standards and programs is one of complement, rather than conflict. Since DOE only increases standards when the technologies required to meet those standards are proven in the marketplace, efficiency programs play a critical role in stimulating market demand for higher efficiency products and generating the critical mass necessary for manufacturers to invest in large scale production. Where Federal standards push low-efficiency technologies out of the market, programs pull up the remainder to a higher echelon of efficiency, establishing a new market norm and setting the stage for future standards. Without programs, DOE could quickly run out of room on standards as the highest efficiency products may have never made it to market, but together they can act as a powerful cycle of efficiency development. In this regard, the interaction between standards and programs is both symbiotic and cyclic.

While some may believe the recent increases in DOE standards have rendered programmatic activity less important, the reality is different. Indeed, DOE standards have rendered *traditional program designs* less applicable (and less cost-effective in many cases), but the need for Energy Efficiency program activity is as strong as ever. What has changed in some markets regulated by DOE is what programmatic activities add the most value.

In those markets where standards have raised the baseline, the programmatic focus can shift to getting the next level of higher efficiency products to market at levels that are cost-effective. In areas where there is a wide efficiency range and considerable potential remaining, that may mean basic rebate programs on the next generation of ENERGY STAR. For others, it could include partnerships with early stage product development, data development, field studies, and messaging to increase consumer awareness.

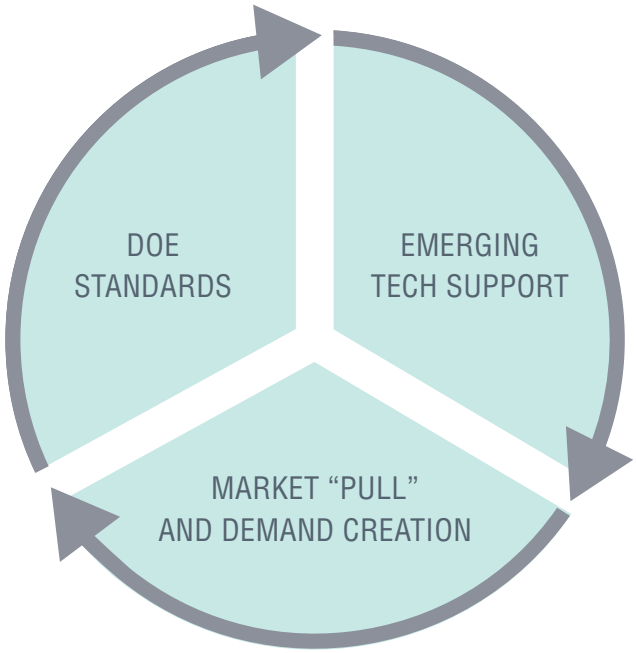


Figure 4
Market transformation cycle

Without programs, DOE could quickly run out of room on standards as the highest efficiency products may have never made it to market, but together they can act as a powerful cycle of efficiency development. In this regard, the interaction between standards and programs is both symbiotic and cyclic.

STRATEGY 1: FILL IN THE GAPS

More savings from already-covered products

Within a given product type, standards typically don't cover every type of product. Sometimes they only cover part of the market. One example is the lighting market in which "decorative" lighting is not subject to standards. Effectively, this leaves a large portion of the market unregulated.

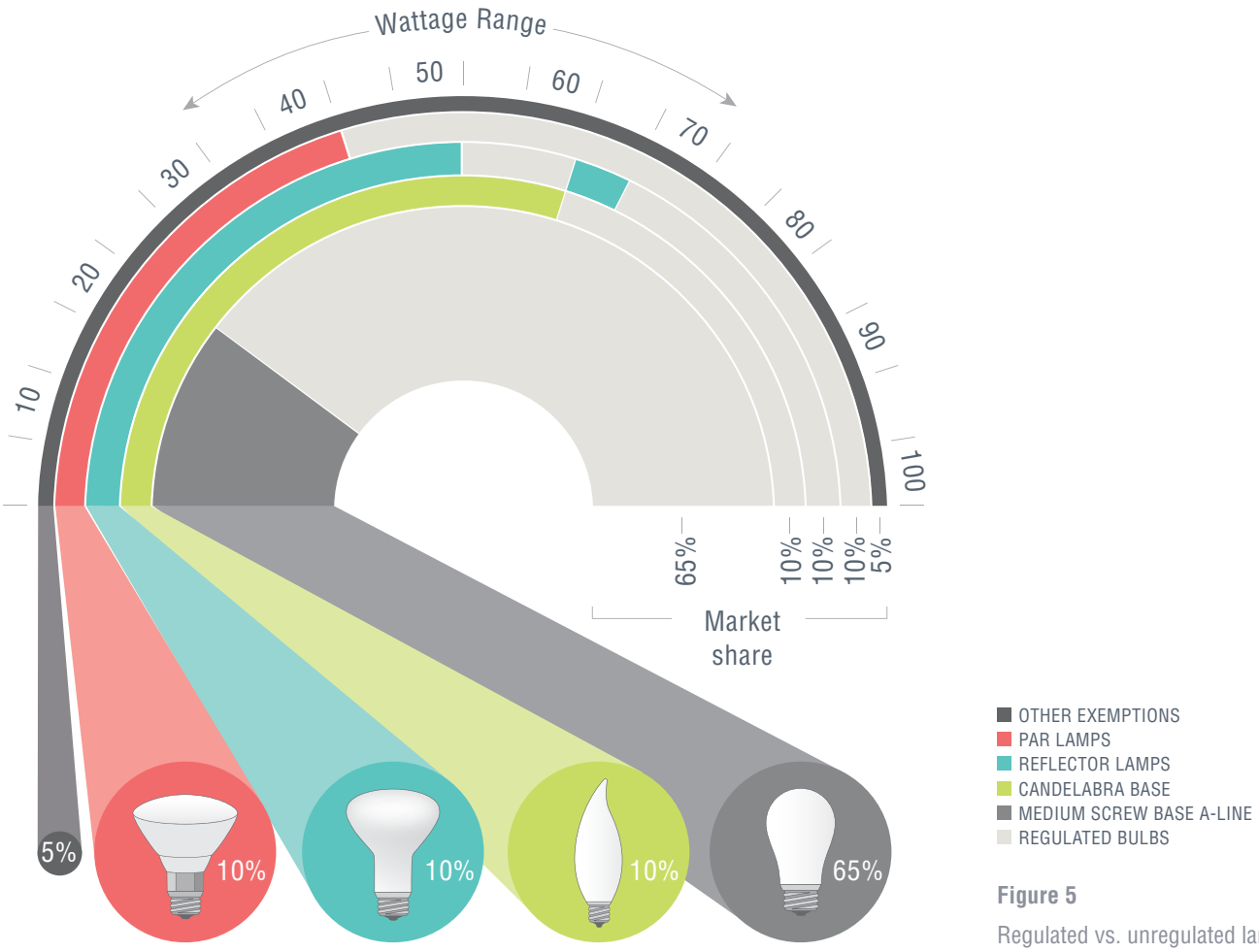


Figure 5

Regulated vs. unregulated lamps

Products with non-typical features tend to be left out of the standards fold as well. This is because products are tested for standards compliance with a designated test procedure. The test procedure is designed to be as simple as possible and the benefits of non-standard product features, such as controls, are not always captured. These features can be great targets for program interventions.

Furthermore, standards only cover products at the point of manufacture. They do not address products' performance over time. Program interventions that target repairs and retrofits can save energy beyond standards by keeping appliances in peak form.

STRATEGY 2: GO BEYOND

Raising the ceiling on higher-efficiency products

The purpose of Federal standards is to set a "floor" on energy efficiency and remove inefficient products from the market. This means that manufacturers don't get any credit for going above and beyond the standards. Programs can target super-efficient products that are not incentivized by standards and move the market in big ways. Figure 6 shows examples of products with designs that are vastly more efficient than products just meeting the standard. Products which feature key designs or technologies that offer compelling savings are a prime target for innovative programs.

Generally speaking, Federal standards are designed to apply across the entire nation. But some products are designed to benefit from certain regional weather conditions. An example of this is economizer cooling, a feature that introduces outside air into a commercial refrigerator or walk-in cooler when temperatures outside are cool enough. This feature has no bearing on standards, and while it may not prove useful in the Southeast, it may be highly beneficial in the Northwest. Similarly, other products may be designed to meet regional codes that are more efficient than national standards. Programs can achieve savings beyond standards by focusing on operating characteristics unique to their region.

Finally, standards only cover individual products – they don't cover the interactions between products, or networked systems. For example, Federal standards regulate the efficiency of an air conditioner *when it's running,* but a smart thermostat can keep the air conditioner from running when it's not needed. The easiest kilowatt to save is the one you don't use in the first place… so programs can achieve savings by looking at system-wide effects.

The next section of the guide addresses five specific product groups where there is significant interaction between Federal standards and BPA programs: residential lighting, commercial lighting, residential appliances, residential HVAC, and commercial refrigeration.

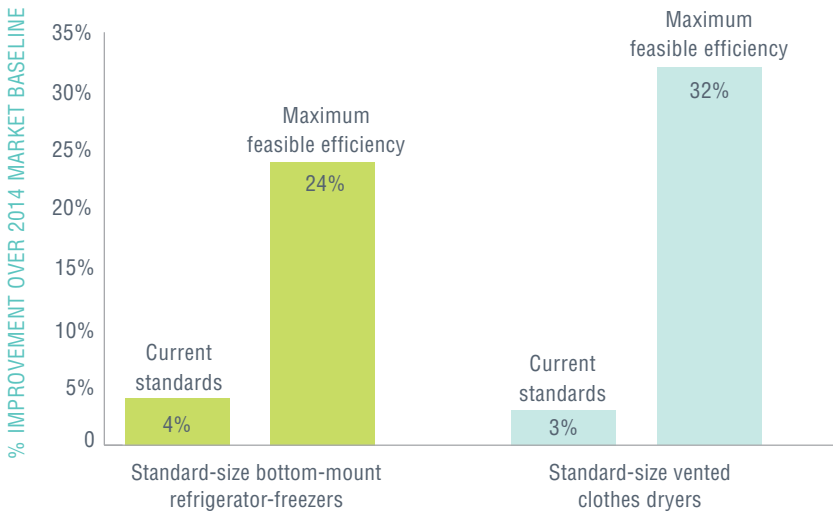


Figure 6

Savings opportunity from max efficiency

SECTION 2: PRODUCT GROUP SPECIFIC FACTSHEETS

PRODUCT GROUP: RESIDENTIAL LAMPS

PRODUCTS COVERED BY FEDERAL STANDARDS:

BASE TYPES:

- Medium Screw Base
- Intermediate Screw Base
- Candelabra Screw Base
- Pin Base

LAMP TYPES:

- A-shape lamps
- Reflector Lamps
- Linear Fluorescent Lamps

In the context of Federal standards, residential lamps are regulated first by the type of socket they go in. Lighting geeks call a lamp's socket type its "base type." By far, the most common base type among residential lamps is medium screw-base.

DOE lighting standards focus on base type because changing the base type of a lamp to skirt the standard renders the bulb fairly useless for the 4 billion medium screw-base sockets in the U.S. The standards are technology neutral, regardless of whether the lamp uses traditional incandescent, halogen, compact fluorescent, or LED technology.

	UNITS	WATTS
Medium screw base	65%	75%
Intermediate screw	5%	5%
Candelabra screw	25%	10%
Pin	5%	10%

Table 4

Northwest retail shelf availability, by base type, 2014 NEEA shelf survey

For some lamp types, DOE further categorizes and sets independent standards on lamps by the bulb *shape.*

A-SHAPE LAMPS

Most of the medium screw base bulbs in the US are "A – Shape" or "A-line." (Fun fact: the "A" is arbitrary. No, seriously, it stands for "arbitrary."). In standards lingo, these lamps are all considered *General Service Lamps.*

All of these lamps have the same "base type," which means that they'll all fit into the same sockets. These lamps make up the majority of sales in the residential sector and are the primary bread and butter for residential lighting programs. They are also common in commercial buildings.

REFLECTOR LAMPS

Another common subset of medium screw-base lamps in the residential sector is reflector lamps. You might have these lamps in your kitchen or hallway in recessed can fixtures. These lamps are covered by different standards and come in a few different types: some of the most common are parabolic aluminized reflector (PAR) lamps and bulged reflector (BR) lamps.

LINEAR FLUORESCENT LAMPS

Most people think of commercial lighting when they think of linear fluorescent lighting. It's the technology you see in just about every office building in the U.S. But, it's also present in the residential sector – think basements, garages, and kitchens.

WHAT DOES EISA MEAN FOR MY PROGRAM?

The Energy Independence and Security Act of 2007 (EISA) set new performance standards for lighting. Lamps and fixtures have had to comply with these standards on a rolling basis starting in 2012. Most efficiency programs have already updated their residential lighting baselines to account for the EISA standards. For example, the RTF baseline assumes that all incandescent or halogen lamps meet the EISA standards. There are still significant savings to be had over the Federal minimum efficacy for programs, especially for LEDs. Every year LED efficacy continues to rise and wattages continue to fall – a great example of opportunity for the go beyond strategy.

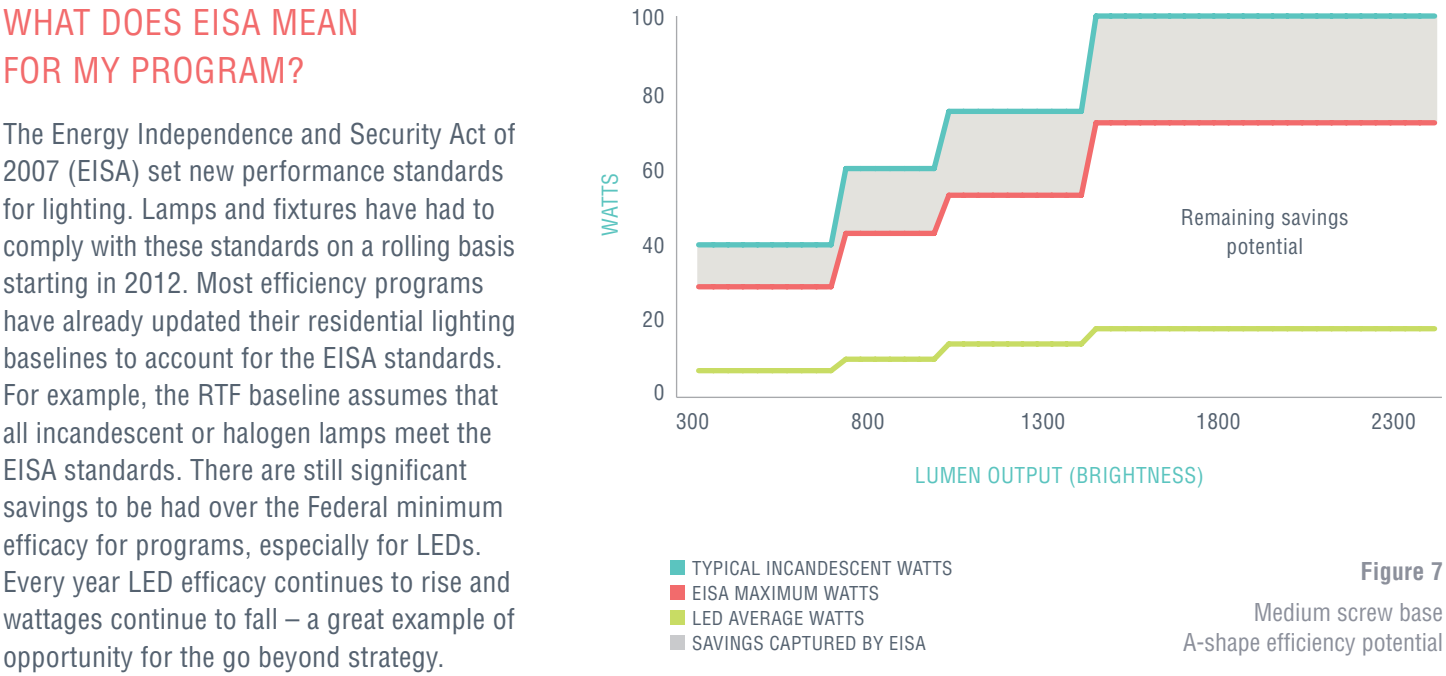


Figure 7

Medium screw base
A-shape efficiency potential

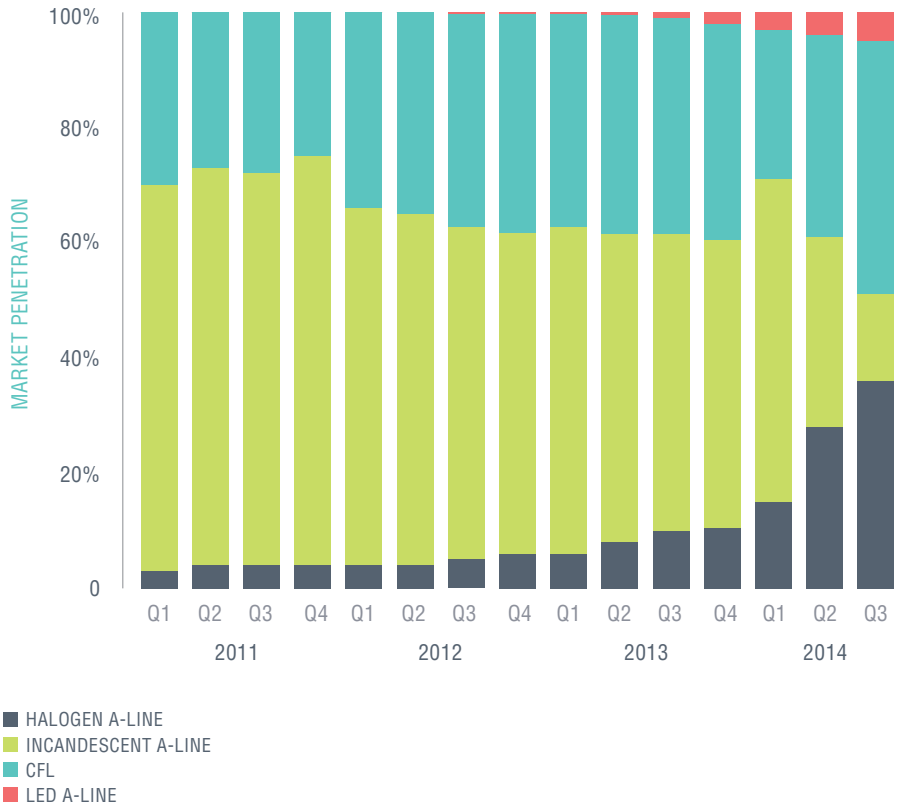


Figure 8

Residential lighting market penetration

STANDARDS, MARKET CHANGE, BASELINES, OH MY.

For common lamps in the residential lighting market, the bigger question is about how fast the market is moving relative to these standards. CFLs are already a big portion of the RTF baseline, and savings between CFLs and LEDs are much smaller than either CFLs or LEDs over the new halogen incandescents. Furthermore, since halogen incandescents are more expensive than traditional incandescents, customers may be more likely to choose CFLs or LEDs in their place.

WHAT'S GOING ON WITH A-SHAPE LAMPS?

CURRENT STANDARDS

EISA legislation marked the first time standards applied to this vast swath of the residential lighting market, setting maximum wattage levels for each screw-in base type. For the medium screw base category, it set 4 different maximum wattage standards depending on how bright the lamp is, often called lumen bins (higher lumens = more light).

WHAT'S NEXT?

EISA requires DOE set lamp standards at 45 lumens per watt or better by 2020. That's nearly as efficient as a typical CFL. The standard will apply to all general service lamps.

EXEMPTIONS, EXEMPTIONS.

There are 22 A-shape incandescent lamp types (e.g., three-way lamps) exempted under EISA, but they represent less than 5% of the market. The larger program opportunity may be in candelabra (mini) base lamps under 60 watts, which are not covered by standards at all. Targeting program efforts on these decorative and specialty categories may make sense.

T12s AT HOME?

Although the commercial market has shifted to more efficient T8s, there are still many older, less efficient T12 systems in the residential market. We'll cover this one more in the commercial lighting section, but a standard aimed at eliminating standard T12 lamps took effect in 2012, forcing the market towards T8 lamps and some lower wattage T12. An exemption for high CRI T12 lamps remains, perhaps making for a good targeted residential program opportunity.

REFLECTORS TOO

CURRENT STANDARDS

Most reflector lamps are regulated by standards similar to the EISA requirements for general service lamps. The standards basically require reflector lamp manufacturers to use halogen technology, which is a bit more efficient than incandescent technology. PAR lamps are covered by this standard, but the most common residential reflector lamp – the 65W BR30 – is exempt. Targeting this product and other similar exempt reflector lamp would make for a great program play.

WHAT'S NEXT?

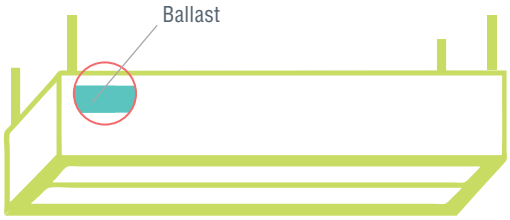
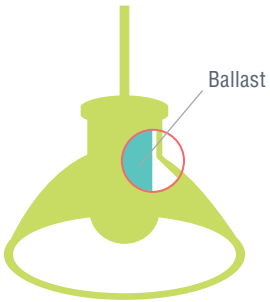
DOE has pushed to close the loophole for BR and other exempted lamps, but there is no clear direction yet.

PRODUCT GROUP: COMMERCIAL LIGHTING

PRODUCTS COVERED BY FEDERAL STANDARDS:

- General Service Fluorescent Lamps (GSFL)
- Mercury Vapor
- Metal Halide

Commercial lighting includes a wide variety of products that compete against each other in various lighting applications. Furthermore, some commercial lighting products include multiple components that are governed by separate standards – making it all really confusing. Sometimes lamps and ballasts are regulated through entirely different (but complementary) standards. The table below explains some of the most common lighting systems in the commercial sector.

SYSTEM	LAMP	BALLAST
FLUORESCENT LIGHTING • Lamp and ballast system • Varying efficiency levels *Provides majority of light in commercial buildings*		
HIGH INTENSITY DISCHARGE (HID) LIGHTING • Lamp and ballast systems • Encompasses Mercury Vapor, Metal Halide, High Pressure Sodium *Common in high bay and exterior lighting*		

LINEAR FLUORESCENT LAMP AND BALLAST STANDARDS: WHAT DO THEY MEAN?

These two standards work together to push the linear fluorescent market away from T12s and especially T12s with magnetic ballasts. In the Northwest, the GSFL baseline already accounts for the market dominance of T8s, which these standards (and programs) helped achieve. Converting T12s to T8s generated a huge amount of savings over recent years, but opportunities are dwindling.

WHAT'S GOING ON WITH GSFL?

CURRENT STANDARDS

Current lamp standards (2012) and ballast standards (2014) are phasing out T12 lamps and magnetic ballasts, respectively. For the most common lamps, efficacy must be at least 89 lumens per watt.

WHAT'S NEXT?

The next lamp standard won't take effect until 2026, but will require about a 4 percent increase in efficacy. Ballast standards will be updated in 2021.

HERE'S THE SKINNY ON HID

CURRENT STANDARDS:

…banned sale of mercury vapor ballasts back in 2008

…have regulated the efficiency of ballasts in NEW metal halide FIXTURES since 2009

FUTURE STANDARDS (2017):

…will have higher ballast efficiency requirements for new fixtures

…will eliminate probe-start ballasts in new metal halide fixtures drawing more than 500W

WHAT DOES THIS MEAN FOR HID IN PROGRAMS?

The metal halide standard really only applies to new fixtures, meaning it is most relevant for current practice baselines. In most programs today, the baseline for HID retrofits is the pre-existing system or pre-condition because none of the individual components of these systems are obsolete. In other words, a commercial facility can continue purchasing replacement lamps and ballasts without needing to comply with this standard. One exception for using a pre-condition baseline for HID systems should be mercury vapor lamps. These systems are much less efficient and the ballasts have been banned altogether for the past eight years.

THE BOTTOM LINE ON COMMERCIAL LIGHTING

The changes in the GSFL market and the acceleration of LED adoption show that the commercial lighting market is changing rapidly. Focusing on the same T12-to-T8 retrofits won't cut it anymore. Programs can stay ahead of standards and push the market further by focusing on applications where LEDs are mature enough to offer a viable and significant savings gain over systems in the ceiling and the rest of the market today. Programs can also fill in gaps where standards cover just components by focusing on the system level: advanced LED systems with integrated controls, anyone?

PRODUCT GROUP: RESIDENTIAL APPLIANCES

RTF PRODUCTS COVERED BY FEDERAL STANDARDS:

- Dishwashers
- Refrigerators and Freezers
- Clothes washers
- Clothes Dryers
- Water heaters

Home appliances represent some of the oldest federal energy conservation standards with initial publications dating back to the late '80s. Current standards for dishwashers, refrigerators and freezers, and clothes washers were incorporated into the RTF measure analysis. Future revisions to these standards, whether on the books or yet to be announced, will impact the measure baseline.

WHAT DO I NEED TO KNOW ABOUT RESIDENTIAL APPLIANCE STANDARDS?

DISHWASHERS

- Standards cover both energy and water use
- Compliance with the current standards has been required since 2013 and manufacturers will have to comply with amended standards starting in 2019

REFRIGERATORS AND FREEZERS

- Standards are based on energy consumption and tied to the volume of the cooled cabinet
- Product classes include standalone refrigerators, freezers, and combination refrigerator/freezers, which are the most common products
- Refrigerator/freezers are distinguished based on the freezer location, whether it be top-mounted, bottom-mounted, or side-mounted
- Compliance with the current standards has been required since 2014

CLOTHES WASHERS

- Standards cover both energy and water use
- Product classes divided by front-loading (horizontal axis) and top-loading (vertical axis)
- Manufacturers must comply with the current standards starting in 2015. New standards for top-loading machines require compliance in 2018

CLOTHES DRYERS

- Standards cover energy use and are based on the weight of clothes dried per unit of energy
- Product classes delineated by fuel used (gas or electric) and if product is vented or ventless
- Manufacturers must comply with the current standards starting in 2015

WATER HEATERS

- Standards cover energy use and are set by efficiency factor
- Product classes delineated by fuel type (gas, oil, or electric) and whether products store hot water or deliver it instantaneously
- Manufacturers have had to comply with the current standards since early 2015

WHAT DO FEDERAL STANDARDS MEAN FOR MY PROGRAM?

Many of these standards have been amended several times over – driving down energy consumption, but also leaving little room for additional savings. The market may reach a point where standards can declare victory over inefficiency.

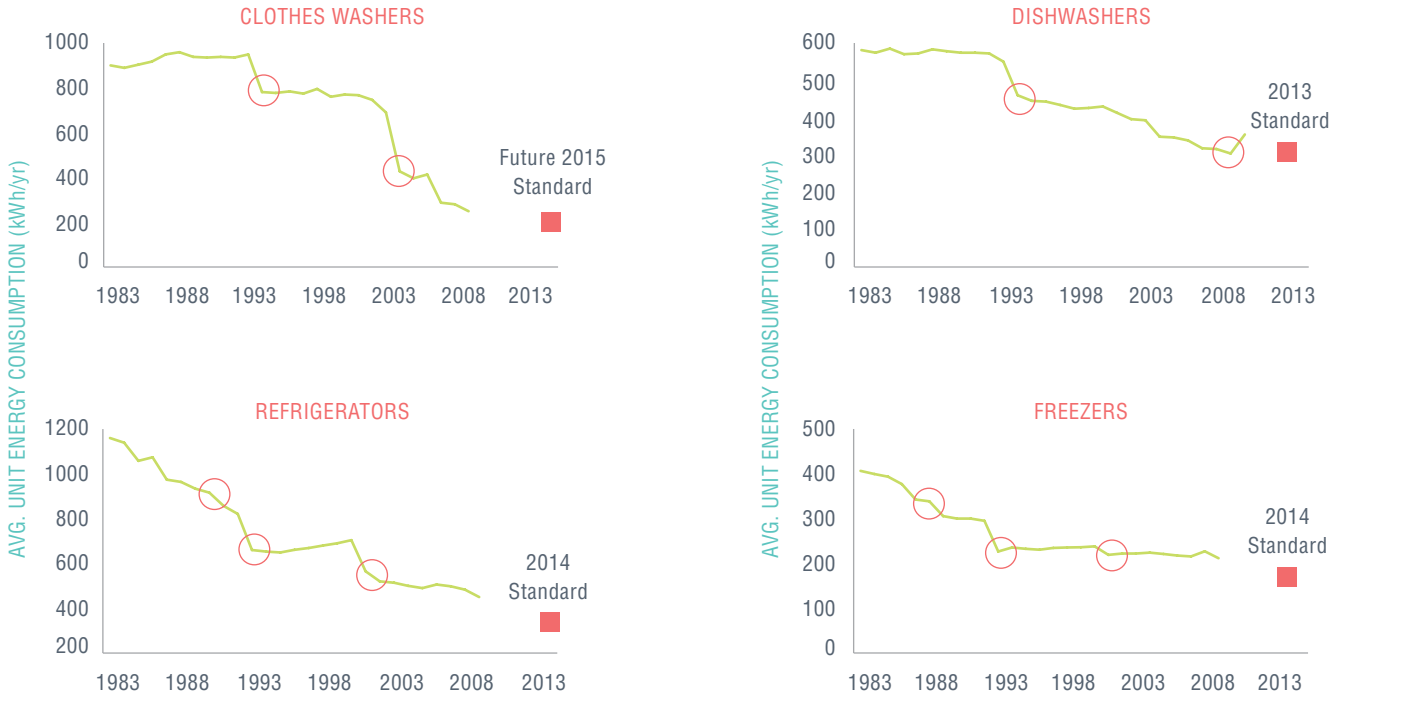


Figure 9

Diminishing returns

As the traditional program design of rebating appliances will see diminishing returns in this scenario, one would think that utility-run programs should consider shifting program focus away from these products entirely. However, utility programs can still play a critical role in delivering additional savings from these home appliances and others.

THE BOTTOM LINE ON RESIDENTIAL APPLIANCES

Programs have the flexibility to operate outside the limitations of federal standards and push the envelope of energy efficient technology.

NETWORKED APPLIANCES Federal standards don't work with the 'internet of things' in that they fail to capture the benefits networked appliances that can respond to dynamic pricing programs. Utility run programs have the power to bring our home appliances into the 21st century.

MAXIMUM EFFICIENCY TECHNOLOGIES Federal standards are also just what their name says – minimum efficiency standards. Where they bring up the rear, utility run programs can get out in front and lead – paving the way by incentivizing maximum efficiency technologies like heat pumps for clothes dryers.

SCREENED OUT FEATURES Federal standards are also limited by the test procedures governing the ratings of appliances. Because of this many high efficiency technologies that are popular in Europe and Asia are screened out of consideration in Federal standards. Features like cold water hookups for dishwashers and automatic cycle termination are two features that don't get the recognition they deserve. While Federal regulations overlook these options, utility run programs can give them their time in the spotlight.

PRODUCT GROUP: RESIDENTIAL HVAC

RTF PRODUCTS COVERED BY FEDERAL STANDARDS:

- Central Air Conditioners and Heat Pumps
- Room Air Conditioners
- Direct Heating Equipment
- Furnaces
- Hearth Products

Residential HVAC equipment covered by standards falls roughly into two types: cooling equipment and heating equipment. Federal standards cover many-different sub-classes of this equipment.

COOLING PRODUCTS

CENTRAL AIR CONDITIONER (CAC)

Cools air and distributes it through ducts to the rooms of your house.

- In a split system CAC, the evaporator and condenser are two different pieces of equipment
- A packaged CAC has the evaporator and condenser in one piece of equipment
- Manufacturers must comply with the current standards starting in 2015

ROOM AIR CONDITIONER (RAC)

- Room Air Conditioner (RAC): Air conditioner located directly in the room it is cooling
- Manufacturers have had to comply with the most recent standards since 2014

HEATING PRODUCTS

CENTRAL HEAT PUMP (CHP)

Heats air and distributes it through ducts to the rooms of your house. *Fun fact: The same piece of equipment – a heat pump – becomes a CAC when it is running in reverse. The same terms and Federal standards apply. Because of the climate in the Pacific Northwest, heat pumps run in heating mode most of the time.*

DIRECT HEATING EQUIPMENT

Burns gas to create heat in the room in which it is located. These products are called space heaters, wall heaters, floor heaters, hearth heaters, and room heaters. Compliance with the current standards has been required since 2013.

FURNACE

- Gas-fired, electric, or oil-fired appliance that heats air and distributes it through ducts to rooms; compliance dates for Federal standards have ranged from 1990 to 2015, depending on the furnace type
- Furnace fans – the part that distributes the air – are regulated separately by DOE

HEARTH PRODUCT

Gas-fired appliance that may or may not provide space heating. It provides aesthetic appeal by simulating a fireplace. There are no standards currently, but in 2015 DOE proposed to eliminate continuously-burning pilot lights.

WHAT ARE RESIDENTIAL HVAC STANDARDS LIKE?

Standards are based on the type of equipment.

COOLING EQUIPMENT is regulated based on Energy Efficiency Ratio or EER. This is the ratio of the cooling capacity to the electricity used. If there is a seasonal component to the standard, it's called SEER (the S stands for Seasonal). If the standard combines efficiency at on, standby, and off modes, it's called CEER (the C stands for Combined).

HEATING EQUIPMENT standards depend on whether equipment uses electricity or fuel to produce heat.

- Heat pumps that use electricity are regulated based on Heating Seasonal Performance Factor or HSPF. This incorporates a seasonal element
- Furnaces and Direct Heating Equipment that use fuel such as oil or natural gas are regulated based on Annual Fuel Utilization Efficiency or AFUE

For all of these metrics, the higher the number, the more efficient the equipment.

THE BOTTOM LINE ON RESIDENTIAL HVAC

Right now, federal standards don't have a big impact on residential HVAC measures. This is because many of the RTF measures focus on replacing a less-efficient with more-efficient product type, while Federal standards can only regulate efficiency *within* a product type.

Program interventions can continue to go beyond standards to save energy. Electric direct heating equipment (e.g. an electric space heater) is not covered by Federal standards and could be a target for program measures. Programs can also achieve savings by looking for *system* improvements not covered by standards, like implementing smart thermostats.

PRODUCT GROUP: COMMERCIAL REFRIGERATION

PRODUCTS COVERED BY FEDERAL STANDARDS:

- Commercial Refrigerators and Freezers (CRE)
- Walk-in coolers and walk-in freezers (WICFs)

Commercial refrigeration is a critical part of the national food chain. It keeps food cold so it can get to you safely. Most commercial refrigeration equipment is found in supermarkets, groceries, restaurants, and convenience stores.

COMMERCIAL REFRIGERATORS AND FREEZERS (CRE)

These are categorized based on three general factors:

- CONFIGURATION refers to whether it is vertical, semi-vertical, or horizontal; and whether or not it has doors.
- THE REFRIGERATION SYSTEM is called "self-contained" or "packaged" if the entire system is built into the product. It is called "remote condensing" or "split-system" if the compressor and condenser are located somewhere else.
- TEMPERATURE: Coolers are warmer than 32 °F; freezers are between 32 °F and -15 °F; and ice cream freezers are -15 °F or colder.

VERTICAL

SEMI-VERTICAL

Compliance with recent Federal standards has been required since 2012. Standards consist of a maximum energy use limit depending on type and size. DOE amended the standards in 2014 and manufacturers will have to comply with the more stringent standards in 2017.

HORIZONTAL

WALK-IN COOLERS AND REFRIGERATORS (WICF)

Walk-in coolers and freezers are just what they sound like: refrigerated spaces that you can walk into.

- Federal standards only cover WICFs smaller than 3,000 square feet
- Manufacturers have been required to comply with the current Federal standards since 2009
- The standards are prescriptive – they require WICFs to have certain components, such as automatic door closers

DOE developed additional performance-based standards for WICF panels, doors, and refrigeration. Manufacturers will have to comply with new standards starting in 2017.

HOW DO THE STANDARDS AFFECT MY PROGRAM?

Commercial refrigeration is made up of many different components that can affect their energy use. RTF measures for these products usually focus on the components – for instance, upgrading from fluorescent to LED case lighting.

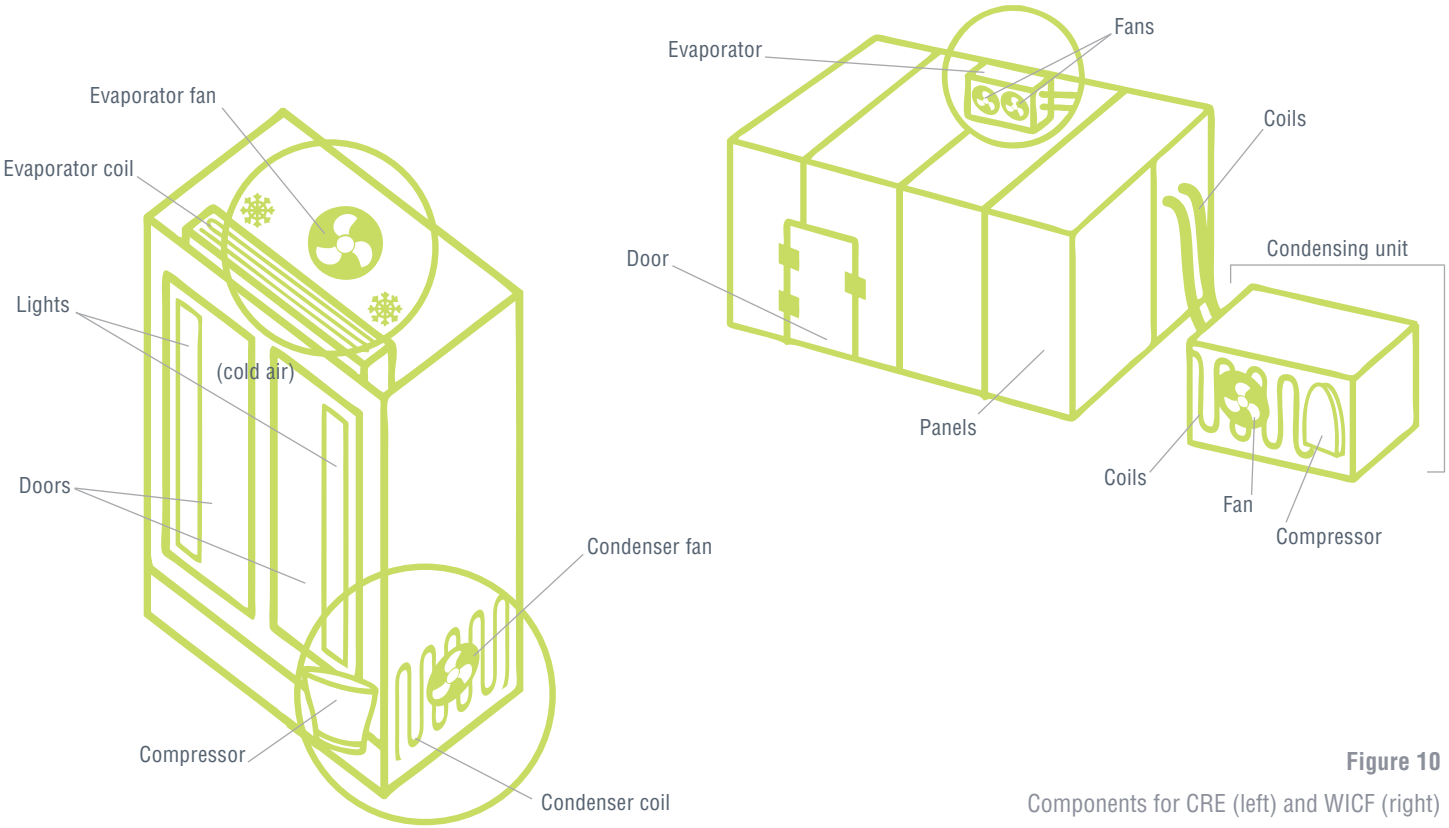


Figure 10
Components for CRE (left) and WICF (right)

Existing Federal standards for CRE and future Federal standards for WICFs are performance-based standards. In other words, the standards do not specify how manufacturers must meet the standards, as long as they reach the required level of performance. But even though Federal standards don't target specific components, manufacturers may still upgrade components of their equipment to meet the standard. Some of the components that manufacturers target for improvement may correspond to RTF measures. In other words, performance-based Federal standards for CRE and WICFs can affect RTF component baselines for these products.

The good news is that program managers can anticipate which components manufacturers are likely to use to meet Federal standards. For CRE and WICFs, DOE performs a cost-benefit analysis of different improvements that manufacturers can make to meet the standard and identifies which ones manufacturers are most likely to make. If any of these improvements correspond to RTF measures, program managers should anticipate RTF baselines or measures changing to account for the fact that manufacturers will likely build their new products with these components to meet the standard.

HOW DOE SETS ENERGY PERFORMANCE STANDARDS

In evaluating potential new standards for commercial refrigeration, DOE determines what the baseline product is and evaluates measures (called "design options") manufacturers could take to improve product efficiency. For each design option, DOE estimates the magnitude of the efficiency improvement (or energy savings) and the additional cost to manufacture the project with the design option added. (Kind of like an RTF measure analysis.) Then DOE orders the design options by their relative cost-effectiveness and plots the efficiency improvement against the cost for each additional option. The resulting graph is called a "cost-efficiency curve."

Figure 11 shows an example of a cost-efficiency curve for a commercial refrigerator. The first measure implemented after the baseline delivers a large efficiency improvement with a relatively small increase in cost. However, once this "low-hanging fruit" is picked, the remaining options deliver successively smaller energy savings for larger increases in cost. So in the context of the graph to the right, replacing motors and adding vacuum insulated panels are both ways manufacturers could meet the new standard – but motors are way more cost-effective.

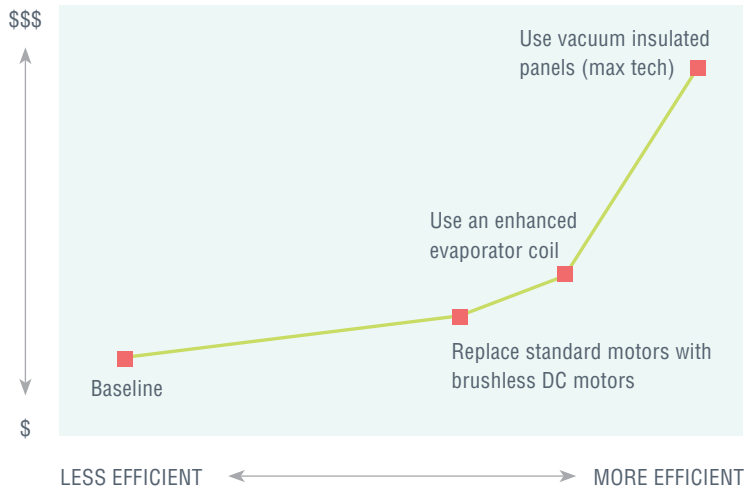


Figure 11
Cost-efficiency curve

THE BOTTOM LINE ON COMMERCIAL REFRIGERATION

New Federal standards for CRE and WICFs are stringent, and manufacturers may implement many or most of the existing RTF measures in an effort to improve their products' efficiency to meet the standards. Program managers should consider different avenues for raising the bar on commercial refrigeration efficiency. For example:

PRODUCT REPAIRS Federal standards do not cover repairs because they only address new equipment when it is built at the factory. RTF measures that incentivize repairs, such as the measure for replacing worn-out gaskets on doors, can save energy beyond standards

ADDRESSING COMPONENTS NOT COVERED BY STANDARDS Future WICF standards only cover the doors, panels, and refrigeration systems of WICFs. Measures that are not encompassed by these components could be targets for RTF measures. For example, a lighting measure that goes beyond the prescriptive level of the current standard would not be covered by the future standards.

REGIONAL MEASURES Some components or energy saving features do not show an energy benefit when the product is rated for compliance with standards, because the rating method is based on conditions that represent a national average. Measures such as economizer cooling, which are beneficial in the Northwest but would not see a benefit in the product rating, could be good candidates for RTF measures.

Contributors

Developed by Rebecca Legett, Angie Lee, Laura Tabor, Navigant Consulting; Rob Carmichael and Ben Barrington, Cadeo Group; and Natalie Phillips, 52echo.

Developed for the Bonneville Power Administration.

Please refer questions to:
Carrie Cobb, clcobb@bpa.gov, 503.230.4985